

# Finnra Engineering News No 9C

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## BREAK-AWAY LIGHTING COLUMNS IN FINLAND, YEAR 2001

An up-dated version of this publication is available in the Internet on page [www.tiehallinto.fi/thohje](http://www.tiehallinto.fi/thohje).

This publication contains a list of approved break-away lighting columns and the criteria for their use. Columns accepted in other EU member countries are accepted as well, when the approval is based on EN 12767 or prEN12767 and prEN 40. However, it is necessary to ensure that the resistance to wind load and the safety level meet the Finnish requirements. The safety requirements are shown on page 5 and 6.

### **Need for a break-away column**

The use of break-away lighting columns is cost-effective when the ADT is at least:

- 1000 vehicles/d, when the speeds used on the road (or street) are about 60 km/h (which can also appear in an area of 50 km/h), and
- 700 vehicles/d when the speeds used on the road are generally at least 80 km/h.

Today more than 90 per cent of new lighting columns installed for Finnra are break-away. Most of them are wood poles or yielding steel constructions, not many slip-base columns. Break-away lighting columns are only slightly more expensive than columns with no passive safety.

### **Need for an energy -absorbing column**

Energy absorbing columns (HE) should be preferred on major roads, when there is an actively used pedestrian way or trees behind a narrow ditch.

In urban roads and streets, with a speed limit 50 to 70 km/h, yielding columns (HE, LE or NE), which bend under the car, should be used. Other kind of columns may sometimes fall on the roof of the impacting car. The risk is highest at low speeds, but even then rather low. Overhead cables reduce the risk caused by a falling column.

Non –energy absorbing columns are normally used, when there is a wide side ditch behind the column.

In practice energy absorbing columns are not used as widely as the recommendation proposes.

**Existing columns**

It is cost-effective to modify existing wood poles to break-away, when the traffic volumes given above are exceeded. For modification of existing steel columns a higher traffic volume limit may be used, because the modification of steel columns is more expensive. It is not necessary to modify 10 m high aluminium columns.

The modification is not necessary or in some cases not possible, when the columns

- a. are behind a safety fence
- b. are behind a side ditch in the midst of thick trees or sufficiently far
- c. are partly decayed and the distance between columns is short
- d. carry heavy transfer lines or the overhead cable angle of a self supported pole is wide.

The Finnish Road Administration is going to modify all modern lighting columns to break-away between years 1994 and 2005 along high volume roads. This way it is possible to reduce the annual number of accidents by almost 100 injuries. The measure is inexpensive since there is no need for modifying electrical cables. Finnra modifies also columns own by municipalities if they are located along public roads.

When modifying wood poles the contractor should be given a compensation for identifying such columns, as well, which are in so poor condition that the treatment is not possible. Identification of these columns requires normally the beginning of the treatment.

Old-fashioned road lighting with old-fashioned lanterns and short distance between the columns should be rebuilt with break-away columns. The reduction in accident costs and energy costs may cover the rebuilding costs in four years when the ADT is 6000 veh/d or more.

**Manufacturers:**

The following impact tested break-away lighting columns are available in the Finnish market; manufacturer (dealer): product

**Products:****Steel columns with slip-base**

Stahlsund Oy, Finland (fax +358 (0)9 222 5457, E-mail: marketing@stahlsund.fi) manufactures and sells: A steel column with a slip-base. Conical is available as well. Overhead cable is possible, too. Thousands have been installed. Slip-base has been improved on the year 1995. Since then the experience has been good.

Tehomet Oy, Finland (fax +358 (0)15 7800 777, E-mail: pentti.kettunen@tehomet.fi): A steel column with a slip-base. Conical is available as well. Overhead cable is possible, too. Thousands have been installed. Slip-base has been improved on the year 1993. Since then the experience has been good.

Östra Stålinindustri as, Norway, (fax +47-70-68 742): steel columns with a slip-base. Overhead cable is possible, too. Thousands have been installed in Norway, but not widely used in Finland.

Petitjean SA, France, manufactures: A steel column with a slip-base. Conical is available as well. Not used in Finland.

**Wood poles**

Vierumäen Teollisuus Oy, Finland (fax +358 (0)3 718 7555): Safepole, a normal wood pole made hollow at the lower end. In an impact the pole breaks at the ground level. Overhead cable is possible, too. Thousands have been installed. Very good experience since 1992. An energy-absorbing alternative exists as well.

JRK Tekniikka Oy, Finland (fax +358 (0)16 515 516) has developed and manufactures: A wood pole with five horizontal holes with a diameter 110...160 mm depending on the pole diameter. The holes may be covered with a thin plate (not present in the test).

Finnforest Oyj, Finland (fax +358 (0)104 65 9503): Luxiroad, carved hollow along a section 0,6 or 1,2 m from the ground surface. The same construction as one of Maansiirto Junttila Oy. In ground cable installation the cables can be hidden inside the column. First approval 19 (1,2 m) and latest approval 2000 (0,6 m).

Lappset Group Oy, Finland (fax. +358 (0)16 320 9100) sells and Martinson Ab in Sweden manufactures: Comwood, a hollow column glued from 12 wood lamellas. The column is activated very easily.

Tehomet Oy, Finland (E-mail: pentti.kettunen@tehomet.fi, fax +358 (0)15 7800 777): A slip-base set for wood poles. Suitable also for cases where the column is fixed in rock.

**Modifying existing wood poles to break-away**

Maansiirto Junttila Oy, Finland (E-mail: maansiirto.junttila@co.inet.fi, fax +358 (0)8 6877 162) has developed and treats. An existing column is carved hollow along a section 0,6 or 1,2 m from the ground surface. Thousands of columns has been treated since 1995. First approval 1995 (1,2 m) and latest approval 2000 (0,6 m).

JRK Tekniikka Oy, Finland has developed and manufactures: An existing wood pole gets five horizontal holes with a diameter 110...160 mm depending on the pole diameter. The holes may be covered with a thin plate (not present in the test).

Finnish Road Administration has developed and contractors have done. A wood pole is made hollow by sawing from 11 directions, then it is filled with plastic foam and covered with wood strips. Thousands has been treated between years 1993 and -98. Has performed well, but during the treatment it is difficult to capture wood particles impregnated with arsenic etc.

Tehomet Oy, Finland : A slip-base set for wood poles. Suitable also for cases where the column is fixed in rock.

Sähkö-Jokinen Oy, Finland (E-mail: simo.jokinen@sahkojokinen.fi, fax +358 (0)2 548 1112): A slip-base set for wood poles. Suitable also for cases where the column is fixed in rock. An energy-absorbing alternative exists as well.

**Modifying existing steelcolumns to break-away**

Maansiirto Junttila Oy, Finland has developed and installs: Teräs-Yrjö, a set for modifying standard steel columns to break-away. The set is less visible than a slip-base and it is made of aluminium and steel. Max acceptable bending moment is 20 kNm (10,3 m height in the Finnish wind conditions). The first sets have been installed in 2000, and the product has been approved 2001.

**Energy absorbing columns and yielding (bending) columns**

Vialumine Oy, Finland (fax +358 (0)9 881 3194) manufactures and SLO Oy, Finland (fax +358 (0)102 83 2020) sells: Vialumine –column, a shoulder type aluminium column with steel bars for stiffening the column before the impact. The height of the column may be adjusted in place. Two alternatives are available:

- a) For installations with ground cable or overhead cable, with a diameter 166 mm. It shall be used with a VIABJ –foundation (concrete) or VIATER-foundation (steel which can be pressed in hard soil without digging). Thousands have been installed with good experience.
- b) For installation with ground cable only, with a diameter 140 mm. It may be used with SJ /VIA –foundations as well. Good experience. The resistance to wind load has been improved 1992.

Sähkö-Jokinen Oy, Finland (E-mail: simo.jokinen@sahkojokinen.fi, fax +358 (0)2 548 1112): A steel column, KAPU. It is conical and is made of steel lamellas. It may be used with overhead cables, too. Shall be installed with SJ-foundation. It has been used since 1994 with good experience.

Sähkö-Jokinen Oy, Finland: A steel column, TURVA. It is conical and is made of steel lamellas. It may be used with overhead cables, too. Shall be installed with SJ-foundation. It has been used very widely since 1995. The design is based on KAPU, but due to reduced number of steel bars, the ability to reduce the exit speed is lower. Approval is based on impact tests done to KAPU.

Tehomet Oy, Finland (E-mail: pentti.kettunen@tehomet.fi, fax +358 (0)15 7800 777): A lattice column, RELE. The lower part is a lattice construction with a thin steel cover and the upper part is like rigid steel column. The column looks like a normal rigid lighting column. It is used with a specified rigid concrete or steel foundation. Widely used in Finland since 1998. (This product differs from a similar product introduced on 1994.).

Stahlsund Oy, Finland (E-mail: marketing@stahlsund.fi, fax +358 (0)9 222 5457): The column is an angular steel pipe with thin steel walls reinforced with steel bars welded on the inner side of the wall. Shall be installed in impact a resistance concrete foundation. First introduced on 1997, but the welding was modified 1998 in order to improve impact performance.

Silux Oy, Finland (fax +358 (0)9 802 1890) sells Varmförszinking Ab manufactures: The ESV-column is an angular steel pipe with thin steel walls reinforced with steel bars welded on the inner side of the wall. A special yielding foundation is used with the columns. Widely used in Nordic countries with good experience. Overhead cables are possible, too, with strengthened columns. Approved in Sweden.

**Approval in Finland** In order to get an approval for a break-away column it is required:

- Acceptable result from impact tests according to EN12767. For highly energy absorbing columns 35 and 100 (or 70) km/h for the largest column size and 100 (or 70) km/h for a 10 m high column is required. For other columns (not HE) two tests are normally required: one at 35 km/h and one at 100 (or 70) km/h for the largest column size. In Finland such a safety level (EN 12767) is required where the THIV is not higher than 27 km/h. If the column is to be sold as energy absorbing column (HE) the columns has to reduce the speed of the vehicle from 100 to 50 km/h or from 70 to 5 km/h. (In approvals given before the year 1999 also tests done according to draft or prEN 12767 were accepted. For non-energy absorbing columns one or two tests with 35 km/h was sufficient, and for energy absorbing (HE) one test with 35 km/h and one test with 100 (or 70) was sufficient, but the missing test has to be done by the end of year 2002.)

- Columns higher than 12.5 m are not classified as break-away. On wide central reserves without safety barriers 15 m or 18 m high columns are sometimes used. They are manufactured by Vialumine, Tehomet and Sähkö-Jokinen. In these cases one should prefer designs which are based on tested and approved 12 m columns: larger diameter is acceptable but no major increase in material thickness, massive freely falling components shall be avoided.
- Calculations according to SFS 4827 (in future EN 40-3-3) must show that the column resists a wind load of 0,66 kN/m<sup>2</sup> or 0,83 kN/m<sup>2</sup> (in future load given in EN 40-3-1, terrain c. II,  $v_{ref} = 23$  m/s) and the displacement at the top of the bracket is not higher than 6 per cent of the length of the column and bracket.
- Columns which are to be used with overhead cables shall be tested in a way which shows that the column and the fixing can stand the design loads and the deflection remains within the limits: max deflection a) 0.02 H with is load  $0.15*(F_x+F_y)+F_b$ ; b) 0.1H (steel and aluminium) or 0.05 H (wood and plastic) with  $1*(F_x+F_y)+F_b$ ; c) max permanent displacement 0.005 H after  $1.4*(F_x+F_y)+F_b$  load. H = height of the pole,  $F_x$  = horizontal load from the cable 1.1 or 1.3 kN at a height of 9.3 m,  $F_y$  = vertical load from the cable 3.7 kN and  $F_b$  = load of the bracket and lantern.
- Durability is evaluated on the basis of material specifications
- Electrical installations are inspected, if they differ from standards.
- Installation instructions are studied and approved

### Energy absorbing (HE) columns

Approved in EN 12767 class HE100 and safety level 3 (THIV  $\leq$  27 km/h) for roads with speed limit 120 km/h or lower:

Product	Height for use	Test height (Speed class safety level, exit speed)
Vialumine OMK 140 mm	12 m	12 m (100,3,49)
Vialumine OIK 180 mm	12 m	
- " - with overhead c.	10 - 12 m	12 m (70,3,0)
SJ-KAPU	10 - 12 m	10 m (100,3,35)
- " - with overhead c.	10 - 12 m	
Tehomet, RELE	10 - 12 m	12 m (100,3,0)
Stahlsund (17.10.1998)	10 - 12 m	12 m (100,3,38)

Approved in EN 12767 class HE100 and safety level 3 (THIV  $\leq$  27 km/h) for roads with speed limit 80 km/h or lower:

Vialumine OMK 140 mm	10 - 12 m	12 m (100,3,49)
Vialumine OIK 180 mm	10 - 12 m	
- "- with overhead c.	10 - 12 m	12 m (70,3,0)
SJ-KAPU	10 – 12 m	10 m (100,3,35)
- " - with overhead c.	10 - 12 m	
Tehomet RELE	10 - 12 m	12 m (100,3,0)
Stahlsund (17.10.1998)	10 - 12 m	12 m (100,3,38)
ESV	10 m	
- " - with overhead c.	10 m	
SJ-slip-base + break syst.	10 m	10 m (70,3,0)
Vierumäen t. + break.syst.	10 m	10 m (70,3,0)

**Non-energy absorbing columns**

Approved in EN 12767 class NE100 safety level 2 or LE100 safety level 3 (THIV  $\leq$  27 km/h) for roads with speed limit 120 km/h or lower:

Product	Height for use	Testheight (Test speeds)
Vialumine 140	10 m	12 m (35;100)
Vialumine 180	10 m	
SJ-TURVA	10 - 12 m	(KAPU-tests)
- " - with overhead c.	10 - 12 m	
Stahlsund slip-base	10 - 12 m	12 m (35)
Tehomet slip-base.	10 - 12 m	12 m (35)
Petitjean slip-base	10 - 12 m	12 m (35)
Comwood	10 - 12 m	12 m (35)
Vierumäen t. Safepole	10 - 12 m	12 m (35)
Finnforest Luxiroad	10 m	10 m (35; 100)
JRK Tekniikka	10 m	10 m (35; 100)
Teräs-Yrjö	10 m	10 m(35, 100)

**Price**

The following relative prices are for 10 m high columns with their foundations and brackets. The price is estimated by multiplying the number by 150 – 220 Euro, depending on the purchaser and the dealer.

Rigid wood pole	0,8
Wood pole with a slip-base	1,3
Carved wood pole	1,5
Glue laminated pole	3
Rigid steel column	1,6
Steel column with slip-base	2,2
Conventional aluminium	3,0
Yielding energy absorbing (HE)	2,5
Yielding non HE	2,2
Modification to break-away:	
Slip-base set for steel columns	1,0
Aluminium set for steel columns	< 1
Slip-base set for wood poles	1,5
Carving or sawing of wood poles	0,5

**Durability**

The durability of yielding steel columns is supposed to be somewhat shorter than one of the rigid steel columns. The outer wall in yielding columns like ESV, Stahlsund, KAPU, TURVA and Tehomet-RELE is thinner than in conventional columns. However, the galvanising should give a design life of 30 years. Additional painting may be considered on the lowest 1 m of the column in order to improve durability, which is a common practice in Sweden

In Vialumine columns, made of aluminium and steel, corrosion has been prevented with zinc layer between the metals. Installing of a slip-base set does not either reduce the service life, which may be as long as 50 years. In USA, where slip-bases has been used for many years, the performance of slip-bases has remained for decades. In Finland a stainless steel (or plastic)

is required between the galvanised surfaces of the slip-base.

Also the supposed service life of break-away wood poles is supposed to be somewhat shorter than one of conventional poles. Only the inner part of the pole, where the impregnation does not penetrate, is carved away. Boric acid (2 dl) crystals shall be added in the bottom of the carved or bored room in the column near the ground level in order to improve durability. New columns are carved before impregnation.

<b>Climbing</b>	Finnra does not allow climbing to all break-away wood poles due to occupational safety after the installation, because the prediction or measuring the condition of the column is more difficult than in a normal wood pole. Climbing during the installation may damage the surface of the pole.
<b>Foundation</b>	<p>There is no need for concrete foundation with wood poles. Even steel poles can be installed without a concrete foundation if the corrosion protection is sufficient.</p> <p>Slip-base column requires a good backfill in order to perform well, though new slip-base columns are activated easier than the older ones. The height of the slip-base from ground surface and road has to be correct. Sometimes it is necessary to adjust the slope. Also the backfill for other break-away columns has to be rather good.</p> <p>Yielding columns do not require as good backfill as other columns, but energy absorbing columns and their foundation must not be detached from the ground. The foundation shall be done according to the approval (and test).</p>
<b>Cables</b>	Conventional Finnish installation type is acceptable (thick cables are not fixed directly to the wall of the column).
<b>Overhead cables</b>	It is common that the power is supplied by using cables hanging between the poles. Some of the break-away columns are accepted to be used with overhead cables, too. The cable hook of the yielding columns has to detach or glide during an impact, but the hook of other columns is a normal rigid hook. Then it prevents the column from falling freely on the roof of a car. Finnra has tested the effect of different overhead cable installations on different column types with several impact tests. It is not necessary to test every product with impact test if the hook and the performance, without overhead cables, of the product is similar to one of the tested products when installed.

- Previous numbers:**
1. Break-away lighting columns, current practice in Finland in 1993
  2. Foundations of luminare supports. The effect of backfill on the strains in foundations.
  3. The need of space for snow remover from carriageways in Finland.
  4. Acoustic performance of simple board and plywood fences.
  5. Break-away lighting columns, current practice in Finland in 1996
  6. Break-away lighting columns, current practice in Finland in 1998
  7. The effect of openings on the insertion loss of noise barriers
  8. Improving road side safety on old roads

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## **Finnra Engineering News No 9C**

### **Break-away lighting columns in Finland, year 2001**

**New edition**                      [www.tiehallinto.fi/tlohje/finnra.htm](http://www.tiehallinto.fi/tlohje/finnra.htm)

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